The changes in metabolites in the breast of chicken broilers with different rearing environments and refrigerated storage

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Introduction: In recent years, 1H nuclear magnetic resonance (1H NMR) analysis has been used for the in-depth understanding for metabolic changes in animal muscle and applied for different conditions [1]. Meanwhile, it was reported that various environmental factors (e.g., equipment and facilities, stocking density, and air quality) during chicken broiler rearing can change the metabolite profile of their muscles, due to the stress induced from harsh environment [2, 3]. Such metabolic changes in the chicken broiler with less stressed environment (WB) can be the important information for consumer as it can differentiate its chicken quality from those of conventional one (CB) [4]. On the other hand, the studies on their metabolic differences after slaughter/storage are scarce although the quality of final products is significantly attributed to the changes of storage. Therefore, in this study, we conducted the comparative analysis of metabolites in CB and WB during 7 days of storage.

Materials and methods: The rearing groups were divided based on atmospheric ammonia, floor size, and stocking density. Each 20 birds (Cobb, 1-day-old, initial weight 1.20 0.05 kg) were assigned to two different rearing groups. Until the slaughter on 35 days, both groups were reared under the same farm system and breast meat was collected. Then, the samples were wrap-packed and stored at the refrigerated condition for 1, 3, 5, 7 days. The sample extraction and 1H NMR analysis were performed based on the method of Kim et al. [5]. The spectrum was measured using a Bruker 850 MHz cryo-NMR spectrometer (Bruker Biospin GmbH, Rheinstetten, Germany). All spectra were analyzed using Topspin 4.0.8 (Bruker GmbH). The identified metabolites were used to perform the partial least squares-discriminant analysis (PLS-DA) by MetaboAnalyst 4.0 software. The variable importance in projection (VIP) score was also calculated to suggest the main compounds with a highly contributing variable.

Results: During 7 days of storage, the results of PLS-DA from CB and WB were differentiated and we analyzed the mainly involved compounds on each storage day based on VIP score (> 1). As a result, we found that each 14, but different kinds of metabolites distinguished CB and WB on day 1 and 3; while 9 and 13 metabolites affected the results from day 5 and 7, respectively. During the entire storage, a total of 19 metabolites were mainly related to the metabolic differences of CB and WB. Among them, 6 amino acids - glycine, isoleucine, leucine, phenylalanine, valine, and β-alanine - were consistently found both in CB and WB, regardless of different storage days. The present result indicates that these compounds could play a key role for different metabolic changes in CB and WB during 7 days of refrigerated storage.

Conclusion: Chicken broilers with different rearing environments could be differentiated on entire storage days and six metabolites (glycine, isoleucine, leucine, phenylalanine, valine, and β-alanine) were consistently found as the main compounds. They could be potential candidates for biomarker distinguishing CB and WB during cold storage.

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